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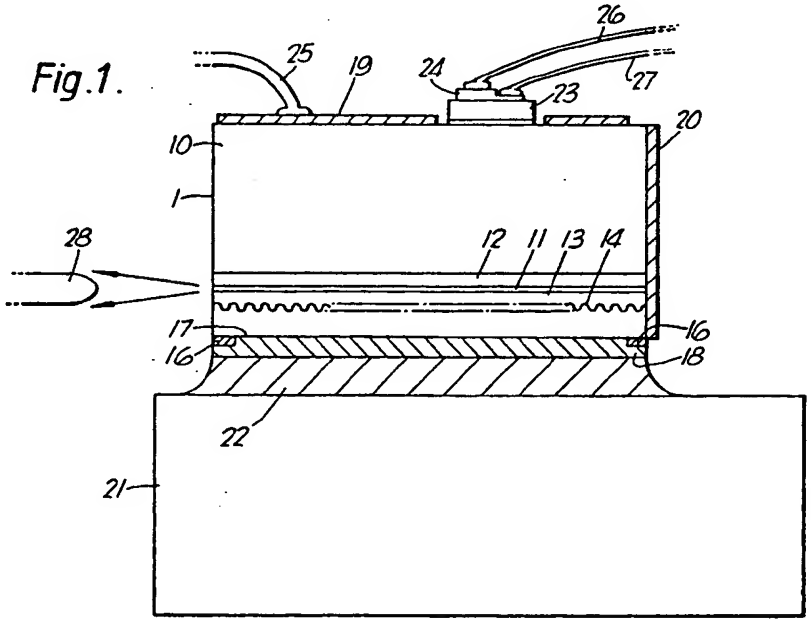
(54) Injection laser and monitor photosensor combination

(57) A distributed feedback (DFB) laser chip (1) has a monitor photodiode (24) mounted upon it in a position where it is able to receive light diffracted by the grating structure (14) of the laser. The photodiode may be mounted on a substrate on the laser or directly on the laser, and may be formed integrally with the laser.

Fig.1.



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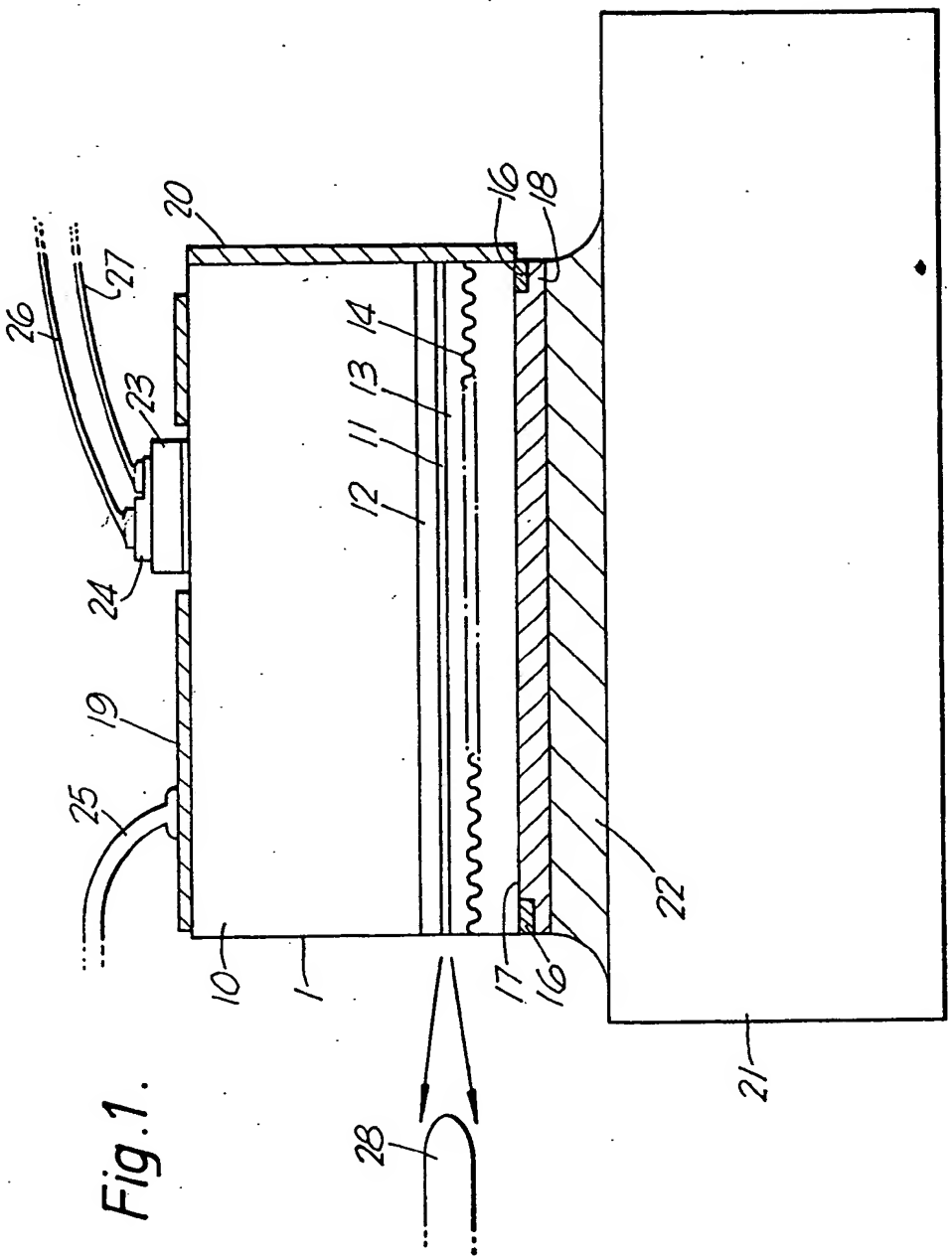

Fig.1.

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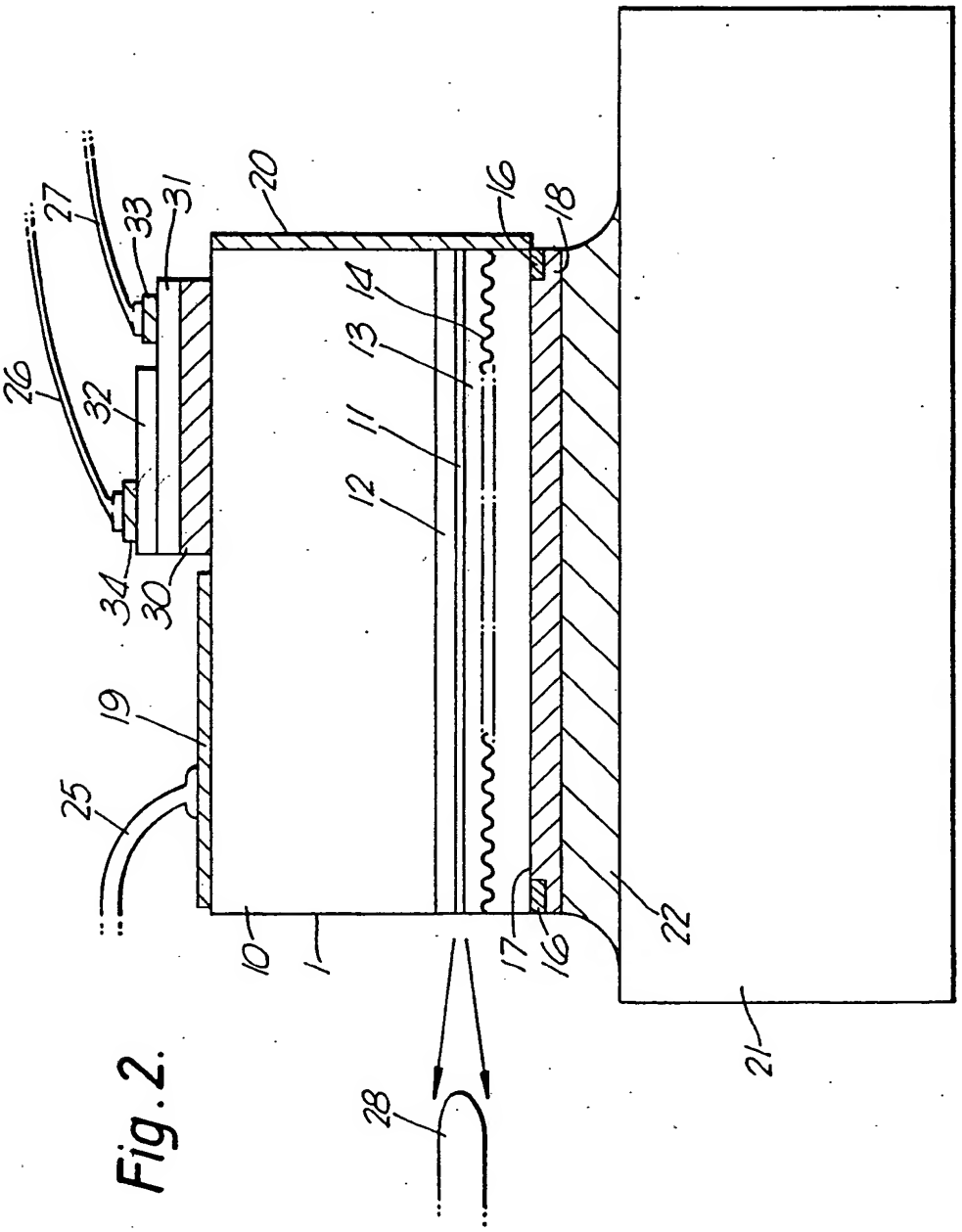

Fig. 2.

SPECIFICATION

Injection laser and monitor photosensor combination

This invention relates to the provision of monitor photosensors for injection lasers. In the case of Fabry Perot type lasers a conventional arrangement involves locating a monitor photodiode behind the rear facet of the laser, but in the case of distributed feedback (DFB) lasers such an arrangement is not always convenient, particularly if the DFB laser construction calls for a high reflectivity rear facet.

According to the present invention there is provided an injection laser and monitor photosensor combination wherein the laser is a distributed feedback laser and the photosensor is located to receive light diffracted and/or scattered out of the junction plane of the laser by the distributed feedback structure of the laser.

This invention makes use of the fact that, when a second order grating is operative to provide distributed feedback for an injection laser, a certain proportion of the laser light is diffracted by the grating into a radiation mode at right angles to the junction plane. Some of this diffracted light is used for monitoring the laser output. In theory a perfect first order grating should not diffract optical power out of the junction plane, but in practice a real grating departs from the ideal enough to cause sufficient scattering of the light for monitoring purposes. Third and higher order grating will also diffract some power out of the junction plane.

There follows a description of two alternative injection laser and monitor photodiode combinations embodying the invention in preferred forms. The description refers to the accompanying drawings in which:

Figures 1 and 2 schematically depict the two combinations.

A laser chip 1 is provided which comprises a transparent semiconductive substrate 10 upon which a number of layers are epitaxially grown, including an active layer 11 sandwiched between two waveguiding layers 12 and 13, in one of which is formed a diffraction grating 14 to provide distributed feedback. Typically the substrate is InP and the active layer is InGaAsP, but other semiconductor combinations are possible. Covering the epitaxial layers is an insulating layer 16 in which a window 17 is provided to allow a metal contact layer 18 to make electrical contact with the underlying semiconductive material. A second contact layer 19 is provided on the under-surface of the substrate 10, and one end facet of the laser chip 1 is provided with a reflecting coating 20.

The laser chip 1 is mounted with its epitaxial layers face-down upon an electrically conductive heat sink 21, being bonded thereto by which is transparent to the laser light and upon which is mounted a monitor photodiode 24, is itself mounted upon the laser chip substrate 10 in an aperture formed in contact layer 19. Suitable materials from which to construct the substrate 23 include silica and mica. Electrical connection with the laser is made by way of the heat sink 21 and a flying lead 25, while electrical connection with the monitor photodiode is made by way of flying leads 26 and 27. The laser output is depicted as being launched into the lensed end of an optical fibre 28.

Instead of mounting the monitor photodiode upon a substrate which is itself mounted upon the laser chip, the photodiode may alternatively be directly mounted upon the laser chip or may be formed integrally with that chip.

An example of an integral structure is depicted in Fig. 2. This structure is prepared by two-sided epitaxy. The layer structure for the laser is the same as that of the laser part of the structure of Fig. 1 but, before these laser layers are grown, the diode structure layers are grown. These comprise a semi-insulating isolation layer 30 and then the active layers of the photodiode.

In the case of a laser structure with an active layer of GaInAsP grown upon an InP substrate, the isolation layer 30 is typically a layer of semi-insulating InP and the active layers of the photodiode comprise an n-type layer 31 and a p-type layer 32, both of InP and respectively provided with contact layers 33 and 34 for attachment of the flying leads 26 and 27.

CLAIMS

1. An injection laser and monitor photosensor combination wherein the laser is a distributed feedback laser and the photosensor is located to receive light diffracted and/or scattered out of the junction plane of the laser by the distributed feedback structure of the laser.

2. A combination as claimed in claim 1 wherein the monitor photosensor is a photodiode chip mounted upon a substrate itself mounted upon the laser chip.

3. A combination as claimed in claim 1 wherein the monitor photosensor is a photodiode chip directly mounted upon the laser chip.

4. A combination as claimed in claim 1 wherein the monitor photosensor is a photodiode formed integrally with the laser.

5. An injection laser and monitor photodiode combination substantially as hereinbefore described with reference to the accompanying drawing.

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